

Full Length Research Paper

The association of ABO blood group and urinary schistosomiasis in the Middle Awash Valley, Ethiopia

Ketema Deribew¹, Zinaye Tekeste^{2*} and Beyene Petros³

¹Department of Biology, Bonga Teacher Education College, P. O. Box 91, Bonga, Ethiopia.

²School of Biomedical and Laboratory Sciences, College of Medicine and Health Sciences, Gondar University, P. O. Box 196, Gondar, Ethiopia.

³Department of Microbial, Cellular and Molecular Biology, College of Natural Sciences, Addis Ababa University, P. O. Box 1176, Addis Ababa, Ethiopia.

Received 08 July, 2012; Accepted 21 November, 2012

The present study was carried out in the Middle Awash Valley, Ethiopia to determine if there was any relationship between the blood group of the human host and urinary schistosomiasis. Patients and Urine and blood samples were collected from 370 children (95 infected and 275 healthy controls) aged 5 to 15 to examine urinary schistosomiasis, hemoglobin concentration and to type blood groups. There were 23 (47.9%) blood group A, 11 (22.9%) blood group B and 2 (4.2%) blood group AB children in the severe schistosomiasis category. Blood group O made up only 25% of severe schistosomiasis patients compared to 56.3 and 53.1% of the mild and healthy controls, respectively. A significant difference was observed in egg load between children with blood group O, 1.63 (0.39) (mean \pm SD) eggs/10 ml urine) and A, 1.93 (0.45) eggs/10 ml urine ($P = 0.03$). Although the mean egg load in children with blood group O was higher than in those with blood group AB, 1.45 (0.21) egg/10 ml urine), the difference was not significant ($P = 0.54$). As compared to the mild schistosomiasis cases, the case of severe schistosomiasis was more likely to be of type A (SS vs. MS: O vs. A, odds ratio (OR) 0.23, 95% confidence interval (CI) 1.62-11.42) and B (SS vs. MS: O vs. B, OR 0.24, 95% CI 1.24-13.76) than type O. The study showed that on the basis of egg load, used to determine severity of urinary schistosomiasis, children with blood group A and B were highly prone to severe urinary schistosomiasis as compared to children with blood group O.

Key words: ABO blood group, urinary schistosomiasis, egg load, mild schistosomiasis, severe schistosomiasis.

INTRODUCTION

Schistosomiasis or biharzia is a tropical disease caused by blood-dwelling fluke worms of the genus *Schistosoma*. Most infections in human caused by *Schistosoma haematobium*, *S. japonicum* and *S. mansoni*, together with a minor contribution from *S. intercalcatum* and *S. mekongi*.

Schistosomiasis is estimated to infect 200 million people around the world while about 600 million are estimated to be at risk of infection (World Health

Organization, 1998). In Ethiopia, *S. haematobium* is endemic in the awash valley (middle and lower awash valley) from Dahitele irrigation scheme on the Amibara/Angele plain to Gewane, Dubti and Assaita area. In the Wabishebele valley (lower Wabi valley), near the Somali border in the villages of Kelafo, Mustahil and Burukur the parasite is reported (Birrie et al., 1998). It is also reported from the western lowlands of Ethiopia such as Kurmuk (Birre et al., 1996).

The relationship between ABO blood groups and susceptibility, resistance, or severity of some diseases has been studied and close correlations demonstrated between blood groups and malaria (Zinaye and Beyene

*Corresponding author. E-mail: zinzn98@yahoo.com.

2010), *S. mansoni* (Ndamba et al., 1997) and oesophagogastric varices (Amer et al., 1971). However, the effect of the ABO blood group on urinary schistosomiasis has received little attention.

However, some studies reported absence of significant association between urinary schistosomiasis and ABO blood groups (Ndamba et al., 1997; Kassim and Ejezie, 1982; Khattab et al., 1968).

For instance, Kassim and Ejezie (1982) reported no significant association between the ABO blood group and *S. haematobium* from two hundred and sixty nine individuals in Epe, Nigeria. In contrast, Ndamba et al. (1997), reported that intensity and annual incidence of *S. haematobium* infection and related organ pathology was significantly higher among children of blood group A and lowest among blood group O children.

These contradictory reports on the association of ABO blood group and urinary schistosomiasis shows the complexity of the interaction between the parasite and the host.

Therefore, the present study was carried out in the Middle Awash Valley, Ethiopia to generate additional data on the association between the blood group of the human host and urinary schistosomiasis.

MATERIALS AND METHODS

Study area and population

The study was conducted in the Middle Awash Valley, Ethiopia. The area is known for long to be infested by the snail intermediate host, *Bulinus abyssinicus* of *S. haematobium*. The study participants were Afar ethnic group. Middle Awash is located at 290 km to the east of Addis Ababa and it is endemic for urinary schistosomiasis (Kloos et al., 1978).

A total of 370 children (95 *S. haematobium* positive and 275 healthy controls) aged 5 to 15 participated in the study.

Of the total 95 *S. haematobium* patients, those harboring > 50 eggs /10 ml urine were considered as cases with severe urinary schistosomiasis infection (World Health Organization, 1983).

Children aged between 5 and 15 years; who had no history of *S. haematobium* drug administration in the two weeks prior to screening, who have no other serious chronic infection, and had ability to give blood and urine samples were included in the study.

Ethical clearance

The study protocol was reviewed and approved by the Ethical Review Committee of the Department of Biology, Addis Ababa University. Written informed consent was

consent was obtained from parents/caretakers of children and assent from the 15 years olds, after explaining the purpose and objective of the study.

Laboratory diagnosis

Urine analysis

Mid stream urine samples were collected between 10 a.m. and 2 p.m., the pick time of egg passage (World Health Organization, 1998). Children are provided plastic urine cups and asked to bring mid-stream urine. Each cup was given a serial number and the volume was recorded. Urine samples were analysed using the centrifugation method as described by Okanla (1991). Briefly, the samples were left to stand on the bench for about 30 min. Following this, the urine in each sample was drawn off leaving the last 10 ml in the bottle. The content of each bottle was shaken to suspend the sediment and was transferred into a 20 ml centrifuge tube. The tubes were centrifuged at 1000 rpm for 5 min. The supernatant was discarded and the residue was put on a clean glass slide and examined under 10x objective lens of the microscope. Intensity of infection was estimated according to the number of eggs per 10 ml urine.

Determination of haemoglobin concentration

Peripheral blood was collected from a finger prick using a sterile blood lancet and analysed by portable, battery-operated HemoCue Hb 201 analyzer (HemoCue AB, Angel Holm, Sweden).

Blood group determination

Blood grouping test was done by standard hemagglutination techniques (Zoysa, 1985).

Briefly, 10 µl (approximately two drops) of whole blood were placed in two different places of a grease-free clean glass slide on which 10 µl of antisera for blood group A and B (ALBAclone® Anti-A, B, USA) was applied. The blood cells and the antigen were mixed with applicator stick. The slide was then tilted to detect for agglutination and the result recorded accordingly (Zoysa, 1985).

Treatment

Children who were positive for urinary schistosomiasis were treated based on the recommended drug regimen. A single dose of praziquantel (40 mg/kg body weight) was given to treat urinary schistosomiasis. Children with severe anemia were referred to the nearby health post and clinic for treatment and further follow up.

Table 1. Characteristics of the study participants.

Category	Total (N)	Mean Hb (g/dl)	Standard deviations (\pm SD)	Mean egg count per 10 ml urine	Standard deviations (\pm SD)
Mild Schistosomiasis	47	12.16	1.39	1.48	0.15
Severe Schistosomiasis	48	11.06	1.63	2.23	0.38
Healthy controls	275	12.20	2.15	NA [‡]	NA [‡]
P- value [†]	NA [‡]		0.001*		0.001*

* Significant difference; † ANOVA; NA[‡], not applicable.

Table 2. Percentage distribution of the ABO blood group types in the study categories.

Category	A (%)	B (%)	AB (%)	O (%)
Mild Schistosomiasis	12 (25.5)	6 (12.5)	2 (4.3)	27 (56.3)
Severe Schistosomiasis	23 (47.9)	11 (22.9)	2 (4.2)	12 (25)
Healthy controls	84 (30.5)	37 (13.5)	8 (2.9)	146 (53.1)

Data analysis

All raw data was entered in to Microsoft excel data base system. The data then imported to SPSS version 15.0 software for analysis. Chi-square was used to determine association. Difference between means was analysed by ANOVA and odds ratios (OR) were calculated with 95% confidence interval (CI). Values were considered to be statistically significant when P-values were less than 0.05.

RESULTS

Characteristics of the study participants

A total of 370 school children were included in this study, 95 were found to be infected with *S. haematobium* and the remaining 275 study participants were not infected by urinary schistosomiasis and are referred as healthy controls. A significant difference was observed in haemoglobin concentration between the mild schistosomiasis, 12.16 (1.39) gm/dl (mean (\pm SD), severe schistosomiasis, 11.06 (1.63) gm/dl (mean (\pm SD) and healthy control cases, 12.20 (2.15) gm/dl (mean (\pm SD) (P =.001) (Table1).

Percentage distribution of the ABO blood group types in the study categories

Out of the 48 severe schistosomiasis cases, 23 (47.9%) were of blood group A, 11 (22.9 %) were of blood group B and 12 (25%) belonged to blood group O (Table 2).

In the mild schistosomiasis cases, there were 12

(25.5%), 6(12.5%), 2(4.3%) and 27(56.3%) blood group A, B, AB and O patients, respectively (Table 2). Blood group O was the dominant blood type in both mild schistosomiasis (56.3%) and healthy controls (53.1%) (Table 2).

The odds ratios and P values for the frequency of O and non-O blood group types between the three study categories

Compared to the mild schistosomiasis cases, a case of heavy urinary schistosomiasis was more than four times as likely to be of type A as to be of type O (SS vs. MS: O vs. A odds ratio 0.23, 95% confidence interval 1.62 to 11.42) and almost twice more likely to be of type AB as to be of type O (SS vs. MS: O vs. AB odds ratio 0.44, 95% confidence interval 0.28-17.91) (Table 3). As compared to the healthy control cases, the case of severe urinary schistosomiasis was more likely to be of type A (SS vs. HC: O vs. A, odds ratio (OR) 0.30, 95% confidence interval (CI) 1.58 to 7.04) and B (SS vs. HC: O vs. B, OR 0.28, 95% CI 1.48 to 8.84) than type O (Table 3).

Mean egg counts, haemoglobin concentration and ABO blood groups in children with urinary schistosomiasis

Intensity of *S. haematobium* infection was significantly higher in children with blood group A (mean (\pm SD) 1.93(0.45) egg per 10 ml urine) than blood group O (mean (\pm SD) 1.63(0.39) egg per 10 ml urine) children (P=0.003). Although the mean egg count in children

Table 3. The odds ratios and P values for the frequency of O and non-O blood group types between the three study categories: patients with severe schistosomiasis (SS), mild Schistosomiasis (MS), and healthy controls (HC).

Blood group compared	SS vs. MS ^x	SS vs. HC ^x	MS vs. HC ^x
O vs. A	0.23,[1.62-11.42],(0.003) *	0.30, [1.58-7.04],(0.001) *	0.49,[0.62-2.69] ,(0.48)
O vs. B	0.24,[1.24-13.76],(0.018) *	0.28,[1.48-8.84],(0.003) *	0.73,[0.44 -3.67],(0.78)
O vs. AB	0.44,[0.28-17.91],(0.43)	0.33,[0.58 -15.95],(0.17)	0.73, [0.15 -0.74],(0.71)
O vs. (A,B and AB)	0.24,[1.69-9.69],(0.0013) *	0.29,[0.15 -0.59],(0.0001)*	1.19,[0.64-1.84],(0.57)

^x values shown are the odds ratios, [95% CI], (P-value).

Table 4. Mean egg counts, haemoglobin concentration and ABO blood groups in children with urinary schistosomiasis.

Blood group compared	Mean haemoglobin concentration	Standard deviations (± SD)	Mean egg count per 10 ml urine	Standard deviations (± SD)
O	11.58	1.62	1.63	0.39
A	11.97	1.72	1.93	0.45
P-value [†]	0.31*		0.003*	
O	11.58	1.62	1.63	0.39
B	11.48	1.32	2.04	0.42
P-value [†]	0.83*		0.001*	
O	11.58	1.62	1.63	0.39
AB	12.00	1.41	1.45	0.21
P-value [†]	0.72*		0.54*	

* Significant difference; † ANOVA.

with blood group O (mean (± SD) 1.63 (0.39) egg per 10 ml urine) was higher than in those with blood group AB (mean (± SD) 1.45 (0.21) egg per 10 ml urine), the difference was not significant (P = 0.54) (Table 4). Furthermore, blood group O children (mean (± SD) 11.58 (1.62) gm/dl) were found to have lower mean haemoglobin concentration than children with blood group A (mean (± SD) 11.97 (1.72) gm/dl) but the difference was not statistically significant (P= 0.31) (Table 4).

DISCUSSION

The present study showed that blood group O confers significant protection against severe schistosomiasis compared with blood group A and B. This is consistent with the study in Zimbabwe (Ndamba et al., 1997), where there was significantly higher intensity of *S. haematobium* infection and related organ pathology among children of blood group A and lowest among blood group O children. Increased incidence of schistosomiasis in group A with a corresponding decreased incidence among group O had also been reported earlier by Khattab et al. (1968).

The mechanism by which ABO blood group affects

disease outcome in schistosomiasis is poorly understood, but a logical explanation lies on the ability of young schistosomula to adsorb host blood group antigens on to their surfaces to mask antigenic sites and prevent specific anti-parasite antibody from binding (Clegg, 1974) and resulting in higher chance of surviving and developing severe form of schistosomiasis (Dean, 1974). This may explain why severity of schistosomiasis was more common in children with blood group A and B than blood group O. On the other hand, earlier studies from Nigeria (Kassim and Ejezie, 1982) and Swaziland (Trangle et al., 1979) have reported the absence of association between schistosomiasis and ABO blood group in the human host. However, the present study has provided evidence that supports the existence of difference between the ABO blood groups and severity of urinary schistosomiasis. Although blood group O was more abundant among the children, the highest intensity of infection was recorded among those children that belonged to blood group A and B.

In conclusion, on the basis of egg intensity used to determine severity of urinary schistosomiasis, the study showed that severity of urinary schistosomiasis was higher in children with blood group A and B than blood group O. Since the mechanism by which ABO blood

group contributes to the severity of urinary schistosomiasis is not clearly defined, further studies to address the subject as it relates to the Ethiopian isolates of *S. haematobium* need to be undertaken.

ACKNOWLEDGEMENT

We are very grateful to the study participants for their cooperation and the health management and working staff of Melka Werer health centre. The study was financially supported by Addis Ababa University and Swedish International Development Cooperation Agency (SIDA/ SAREC).

REFERENCES

- Amer Z, El-Shabraury AE, Sheir ZM, Gorgy AN, Refoi MR. An epidemiological evidence of association between ABO blood groups and ruptured oesophago-gastric varices. *J. Egypt Med. Assoc.*, 1971; 54: 61–67.
- Birre H, Erko B, Balcha F (1996). Decline of urinary Schistosomiasis in Kurmuk town, western Ethio-Sudanese border, Ethiopia. *Ethio. Med. J.*, 34: 47-49.
- Birrie H, Tedela S, Erko B, Berhanu N, Abebe F (1998). Schistosomiasis in Fincha river valley, Wollega region, western Ethiopia. *Ethio. J. Health. Dev.*, 7: 9-15.
- Clegg JA. Host antigen and the immune response in schistosomiasis: mechanism of survival. *CIBA* 1974; p. 161.
- Dean DA. *Schistosoma mansoni*: Adsorption of human blood A and B antigens by schistosomula. *J. Parasitol.*, 1974; 63: 260-267.
- Kassim OO, Ejezie GC. ABO blood groups in malaria and schistosomiasis haematobium. *Acta. Trop.*, 1982; 39: 197–284.
- Khattab M, Gengehy El, Sharaf M. ABO blood groups in bilharzial hepatic fibrosis. *J. Egypt Med. Assoc.*, 1968; 208: 1145–1148.
- Kloos H, Lemma A, Sole DE. *Schistosoma mansoni* distribution in Ethiopia: a study in medical geography. *Ann. Trop. Med. Parasitol.*, 1978; 72:461-470.
- Ndamba J, Gomo E, Nyazema N, Makaza N, Kaondera KC (1997). Schistosomiasis infection in relation to the ABO blood groups among school children in Zimbabwe. *Acta Trop.*, 65: 181–190.
- Okanla EO. Schistosomiasis: influence of parental occupation and rural or urban dwelling on prevalence. *Nig. J. Pure Appl. Sci.*, 1991; 6:154-159.
- Trangle KL, Goluska MJ, Douglas SD. Distribution of blood groups and secretes status in schistosomiasis. *Parasitol. Immunol.*, 1979; 1:133-140.
- World Health Organization (1998). Guidelines for the evaluation of soil-transmitted helminthiasis and schistosomiasis at community level. World Health Organization, Geneva. WHO/CTD/SIP; 98: 1.
- World health organization. Urine filtration technique of *Schistosoma haematobium* infection. World Health Organization Geneva, 1983.
- Zinaye T, Beyene P. The ABO blood group and *Plasmodium falciparum* malaria in Awash, Metehara and Ziway areas, Ethiopia. *Malaria J.*, 2010; 9:280.
- Zoysa D. The distribution of ABO and Rhesus (Rh) blood groups in Sri Lanka. *Ceylon Med. J.* 1985: 30: 37-41.